TECHNICAL MEMORANDUM

INTERIM ESTRELLA ROADWAY, PHASE I RAILROAD CROSSING ALIGNMENT STUDY

PREPARED FOR
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

Gannett Fleming, Inc.
3001 E. Camelback Rd. #130
Phoenix, AZ 85016

April 1996

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1. INTRODUCTION

As part of the final design efforts for the Interim Estrella Roadway (Phase 1), a planning-level analysis has been undertaken to examine alternative railroad crossing options. The Interim Estrella Roadway is located approximately 900 meters southeast of the Beardsley Canal and extends in a southwest to northeast direction for one kilometer either side of Grand Avenue (see Figure 1). The design project is at the 90% stage and includes an at-grade intersection with both Grand Avenue and the Burlington Northern-Santa Fe (BNSF) Railroad.

2. CROSSING OPTIONS

There are five basic design options for Estrella Roadway traffic to cross Grand Avenue and the BNSF Railroad. They are illustrated on Figure 2 and include:

- *At-Grade Crossing* - This involves traffic signalization with railroad pre-emption.
- *Half-Bridge Crossing* - This consists of a 16.8 meter wide bridge over Grand Avenue and the Railroad. It will be constructed on the alignment of the planned southbound freeway lanes (see Appendix A for the ADOT Freeway Plans). It will initially carry two lanes of traffic, but the 16.8 meter width will ultimately accommodate three lanes of southbound traffic.
- *Full-Bridge Crossing* - Two 16.8 meter wide bridges will be constructed as proposed in the ADOT Design Concept Report. Three lanes of traffic in each direction will be accommodated.
- *Tunnel* - This is similar to the Full-Bridge option except that the Estrella Roadway will pass beneath Grand Avenue and the BNSF Railroad.
- *Widened Half-Bridge* - This consists of a 22.2 meter wide bridge over Grand Avenue and the Railroad. It will be constructed on the alignment of the planned southbound freeway lanes. Initially, it will carry one lane in each direction. As traffic volumes increase, it will accommodate two lanes in each direction.

3. TRAFFIC VOLUMES

Figure 3 shows the projected growth in traffic volumes on the Estrella Roadway at Grand Avenue. The data has been excerpted from the Estrella Traffic Analysis Report prepared for MCDOT in 1995.

If the at-grade crossing is constructed in 1996, the intersection's level of service is projected to decline to a Level "E" by the year 2006. This would necessitate construction of one of the grade separation options described above.

If the Half-Bridge Crossing were constructed either initially (Year 1997) or when the at-grade crossing fails (Year 2006), it would accommodate the projected traffic volumes only until the Year 2016 when the Full-Bridge Crossing (or Tunnel) would be warranted.

Construction of the Full-Bridge Crossing, Tunnel, or Widened Half-Bridge is projected to satisfactorily accommodate traffic volumes through the Year 2025.

4. IMPLEMENTATION ALTERNATIVES

Given the five different crossing options and their varying effectiveness in accommodating the projected traffic volumes, this section of the report presents seven distinct implementation alternatives. Each alternative consists of a 20-year scenario during which physical improvements will be phased to meet the growth in traffic volumes.

Figure 4 illustrates an overview of the seven alternatives including the phasing, costs (Future Dollars), and traffic volume projections. Following is a brief description of each alternative:

- *Alternative 1* - Construct the At-Grade Crossing in 1996; the first Half-Bridge in 2006; and the second half bridge in 2016. This alternative best matches the growth in traffic volumes, but requires three separate construction phases.

- *Alternative 2* - Construct the At-Grade Crossing in 1996; and a Full- Bridge in 2006. Although this provides more capacity than is needed in 2006, the construction phases have been reduced to two.

- *Alternative 3* - Construct the At-Grade Crossing in 1996; and a Tunnel in 2006. This is similar to Alternative 2 except for the profile along the Estrella Roadway.

- *Alternative 4* - Construct the Half-Bridge Crossing in 1997; and the Second Half-Bridge in 2016. This provides excess capacity in the early years, but requires only two construction phases.

- *Alternative 5* - Construct the Full-Bridge in 1997. This provides excess capacity in the early years, but requires only one construction phase.

- *Alternative 6* - Construct the Tunnel in 1997. This is similar to Alternative 5 except for the profile along the Estrella Roadway.

- *Alternative 7* - Construct the widened Half-Bridge in 1997. This is similar to Alternative 4 except that the second half bridge is not required.

Figure 5 presents a summary of the features for each alternative. Cost information in Figure 5 is given in both constant 1996 dollars and in future-year dollars (assuming 5% per year). Itemized cost estimate details are presented in Appendix B.

5. EVALUATION OF ALTERNATIVES

In order to evaluate the relative merits of each alternative, a listing of five criteria were established. These criteria were chosen to focus on economics and user impacts. They include:

- *Total Cost* - This represents the future year costs which are the amounts to be programmed from each agency's budget.

- *Initial Cost* - This represents the amounts needed in 1996 to implement only Phase 1 of each alternative. This is an important variable since most agencies have already programmed their 1996 funds.

- *Maintenance Costs* - For this analysis, all alternatives were ranked equally, except for the tunnel.

- *Maintenance and Protection of Traffic* - Those alternatives with the smaller number of phases were ranked more favorably. However, the tunnel (1 phase) was penalized due to a complex construction detour scheme for Grand Avenue traffic and the BNSF Railroad.

- *Accident Potential* - Alternatives with the at-grade crossing were penalized due to the higher number of potential traffic conflicts through the signalized intersection. In addition, the widened half-bridge was penalized due to its concrete median barrier.

Figure 6 summarizes the results of the evaluation. Alternatives 7 and 5 scored the best with their only drawback being a higher initial cost in 1996.

6. REALIGNMENT OF 163RD AVENUE

As part of this study, realignment of 163rd Avenue was analyzed. The goal was to close the existing 163rd/BNSF Railroad Crossing and realign 163rd Avenue southeasterly to the Estrella Roadway (with its new BNSF Railroad Crossing). As can be seen on Figure 7, there are numerous constraints and design issues including:

a. Maintaining a 90 kph (55 mph) design speed
b. Minimizing impacts to established land uses
c. Crossing the Beardsley Canal
d. Crossing the McMicken Channel
e. Providing vertical clearance to the overhead transmission lines
f. Aligning with the proposed Deer Valley Drive by Del Webb
g. Mitigating flood plain impacts (see Appendix C)

Two alternatives are shown on Figure 7. Alternative A satisfies all of the above issues except for the clearance at the transmission lines. It passes beneath the lines at their lowest sag elevation and would require three new towers to raise the lines. Alternative B passes beneath the power lines adjacent to a tower, thereby improving the likelihood of adequate vertical clearance. However, it impacts a portion of an established land use and it does not align with Deer Valley Drive.

Figure 8 presents the cost estimates for Alternative A and B. The costs are in 1996 dollars and do not include right-of-way. See Appendix B for cost estimate details.

7. RECOMMENDATIONS

Based on the analyses and data presented in this report, the following recommendations are advanced:

- If additional funding can be obtained, Alternative 7 the widened Half-Bridge Crossing should be constructed. It represents the least total cost alternative; would have the least impact on the traveling public; and avoids construction of an at-grade railroad crossing.

- If additional funding cannot be obtained, the at-grade crossing should be constructed as an interim facility with the widened half-bridge to be built in 2006.

- If closure of the 163rd/BNSF railroad crossing is ever required or desired, Alternative A realignment of 163rd Avenue should be adopted. Prior to finalizing this alignment, additional field survey is required to establish the optimum location for underpassing the power lines.

8. REVENUE SOURCES

In an attempt to identify potential funding sources for implementation of Alternative 7, a series of two meetings were held with involved stakeholders. Meeting attendees included:

- MCDOT
- ADOT
- BNSF Railroad

- City of Surprise
- Landowners

Meetings were held at the MCDOT offices on January 31, 1996 and February 22, 1996. Minutes of these meetings are included in Appendix D. Although no significant funding sources could be identified at these meetings, an issue of providing direct access ramps to/from the Estrella Roadway at Grand Avenue was raised. In response to this, Figure 9 illustrates a concept of providing loop ramps on the west side of Grand Avenue to/from the Estrella Roadway. These ramps and associated roadway improvements are estimated to cost $3.5 million. In addition, approximately 76 acres of extra right-of-way would be required.

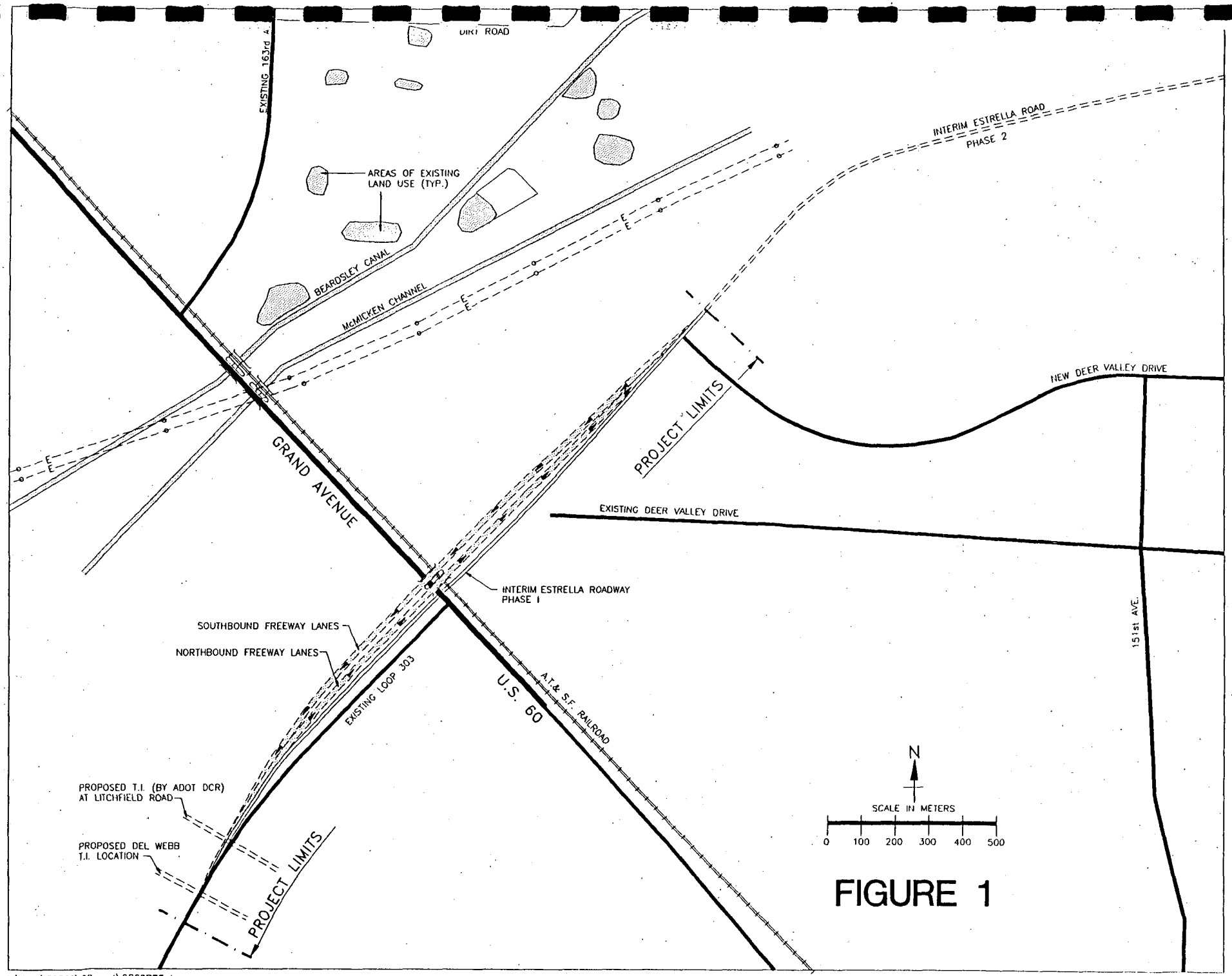

FIGURE 1

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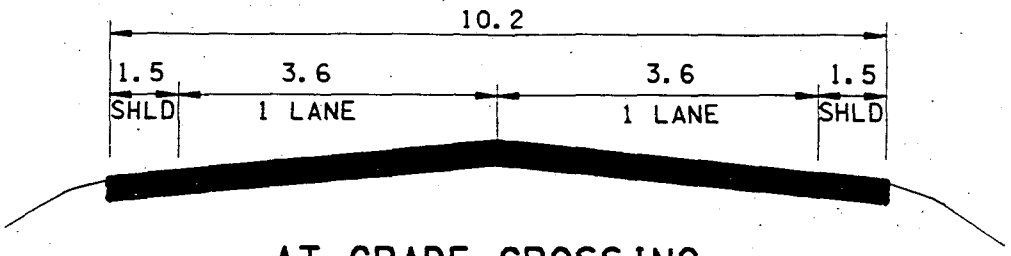
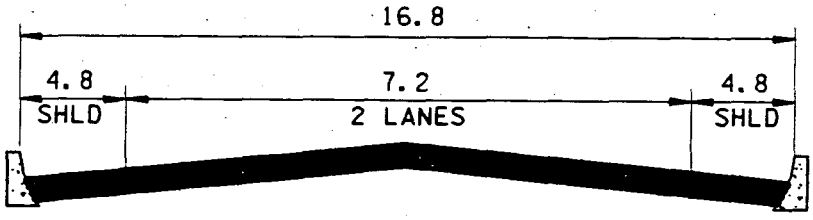
APPLE PLOT

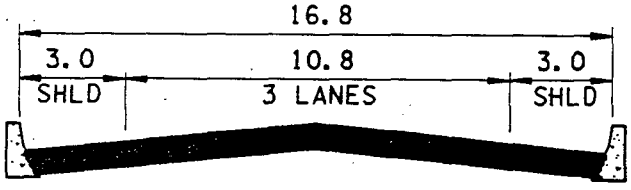
TYPICAL SECTIONS

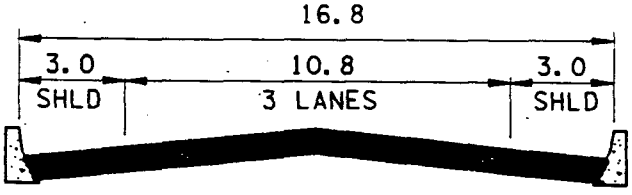


AT-GRADE CROSSING

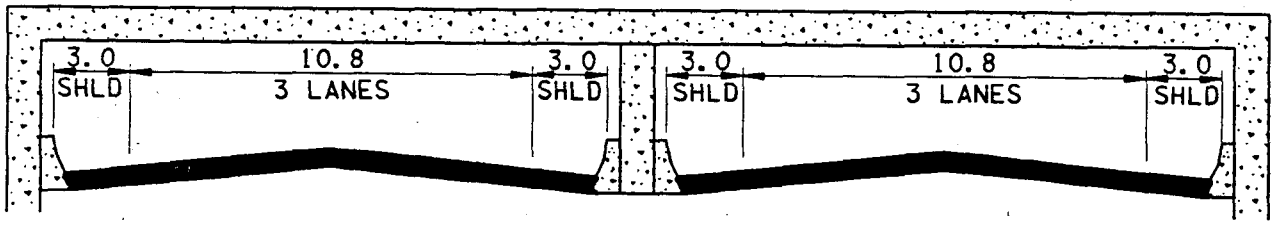


HALF-BRIDGE

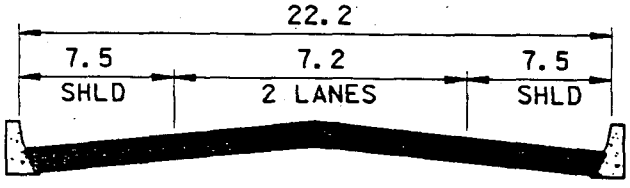




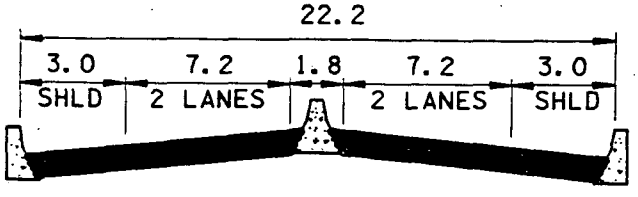
FULL BRIDGE



TUNNEL



INITIAL

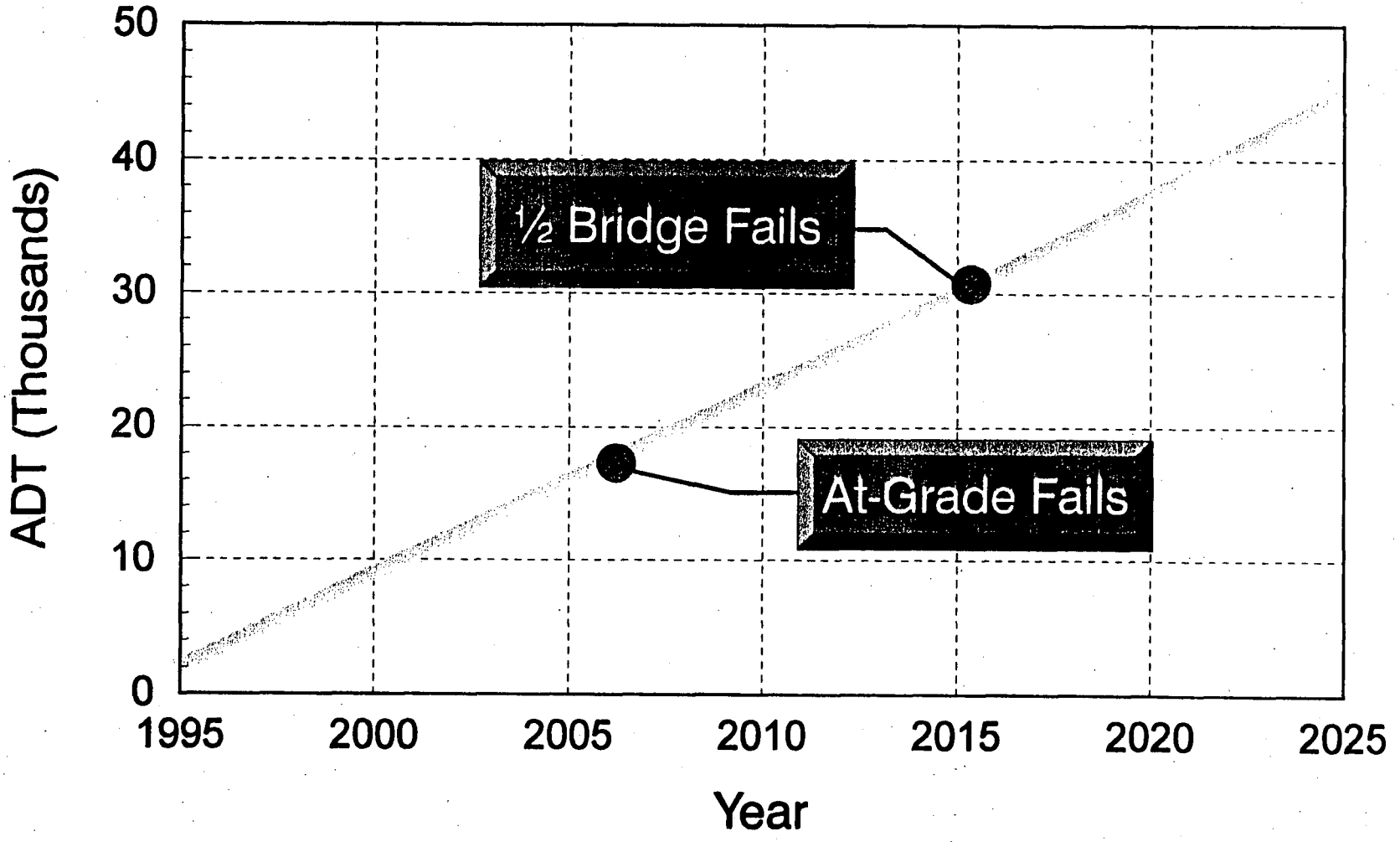


ULTIMATE

WIDENED HALF-BRIDGE

FIGURE 2

Estrella at Grand Avenue



TRAFFIC VOLUME GROWTH

FIGURE 3

RAILROAD CROSSING ALTERNATIVES

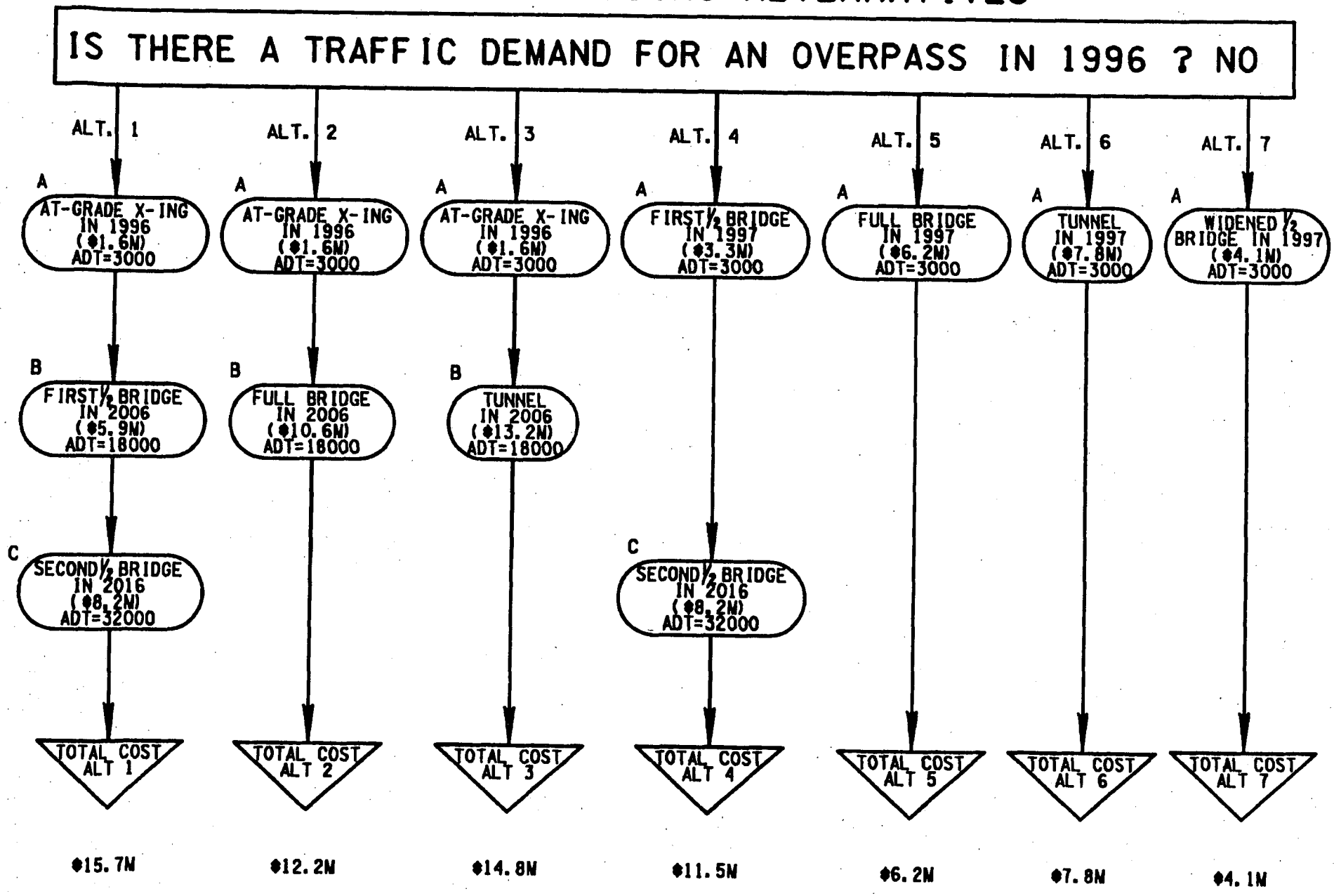


FIGURE 4

FIGURE 5

ALTERNATE	PHASE	DESCRIPTION	YEAR BUILT PER ALTERNATE	ESTIMATED A.D.T. IN YEAR BUILT	YEAR REQUIRED PER TRAFFIC STUDY	ESTIMATED CONSTRUCTION COST (1996 $)	ESTIMATED CONSTRUCTION COST (Future $)
1	A	At Grade X-ing	1996	3000	1996	$1.6M	$1.6M
	B	First Half Bridge	2006	18000	2006	$3.6M	$5.9M
	C	Second Half Bridge	2016	32000	2016	$3.1M	$8.2M
			ALTERNATE 1 TOTAL COST			**$8.3M**	**$15.7M**
2	A	At Grade X-ing	1996	3000	1996	$1.6M	$1.6M
	B	Full Bridge	2006	18000	2006	$6.5M	$10.6M
			ALTERNATE 2 TOTAL COST			**$8.1M**	**$12.2M**
3	A	At Grade X-ing	1996	3000	1996	$1.6M	$1.6M
	B	Tunnel	2006	18000	2006	$8.1M	$13.2M
			ALTERNATE 3 TOTAL COST			**$9.6M**	**$14.8M**
4	A	First Half Bridge	1997	3000	2006	$3.3M	$3.3M
	B	Second Half Bridge	2016	32000	2016	$3.1M	$8.2M
			ALTERNATE 4 TOTAL COST			**$6.4M**	**$11.5M**
5	A	Full Bridge	1997	3000	2016	$6.2M	$6.2M
			ALTERNATE 5 TOTAL COST			**$6.2M**	**$6.2M**
6	A	Tunnel	1997	3000	2016	$7.8M	$7.8M
			ALTERNATE 6 TOTAL COST			**$7.8M**	**$7.8M**
7	A	Widened Half Bridge	1997	3000	2006	$4.1M	$4.1M
			ALTERNATE 7 TOTAL COST			**$4.1M**	**$4.1M**

FIGURE 6

EVALUATION OF ALTERNATIVES

Alt No.	Description	CRITERIA					Score
		Total Cost	Initial Cost	Maint. Cost	M&P Traffic	Accident Potential	
1	At Grade/Half/Half	3	1	2	3	3	12
2	At Grade/Full	3	1	2	3	3	12
3	At Grade/Tunnel	3	1	2	3	3	12
4	Half/Half	3	2	2	2	1	10
5	Full	2	3	2	1	1	9
6	Tunnel	2	3	3	3	1	12
7	Widened Half	1	2	2	1	2	8

LEGEND:

3 = Higher
2 = Moderate
1 = Lower

Note:

Lowest score represents the better alternate

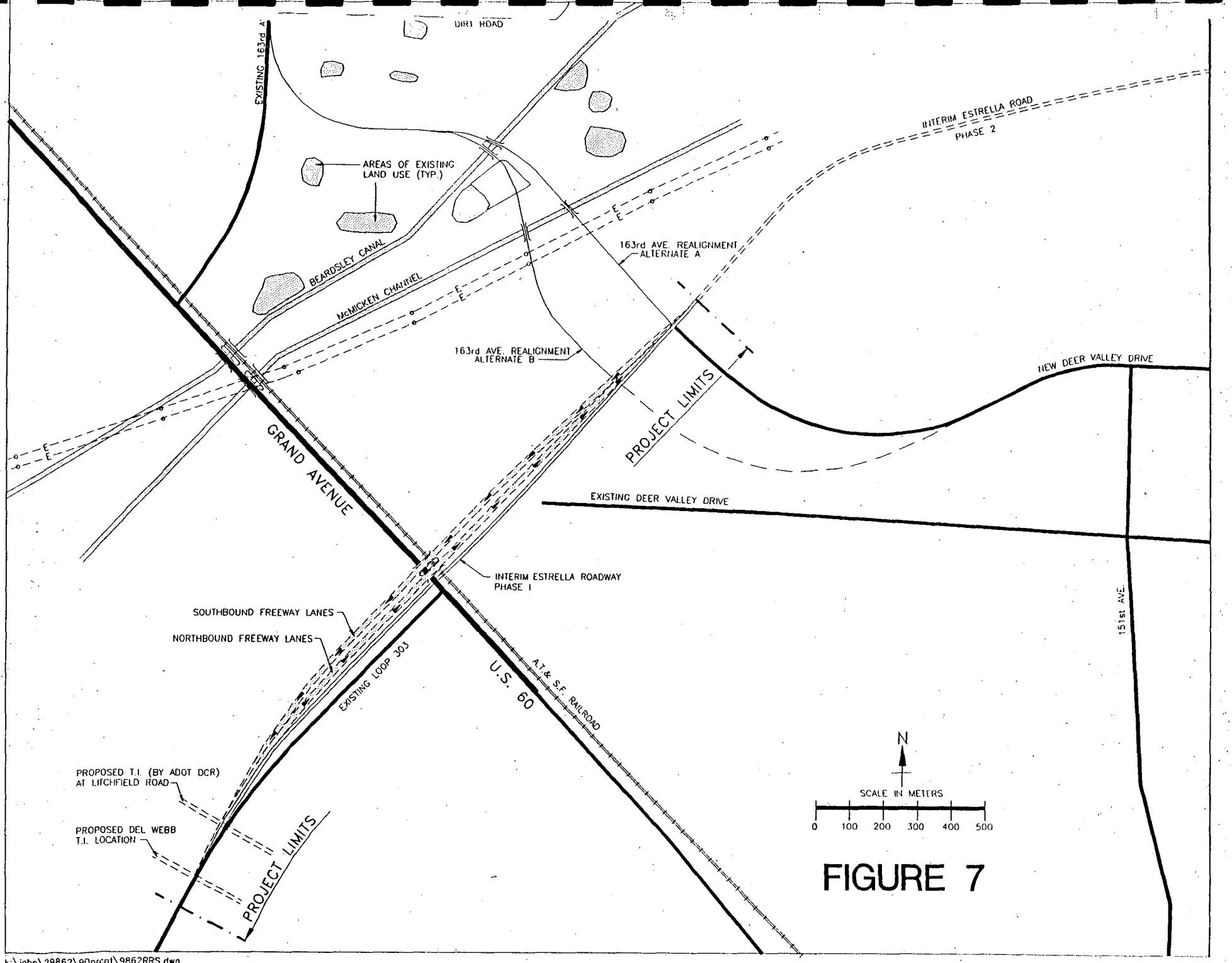


FIGURE 7

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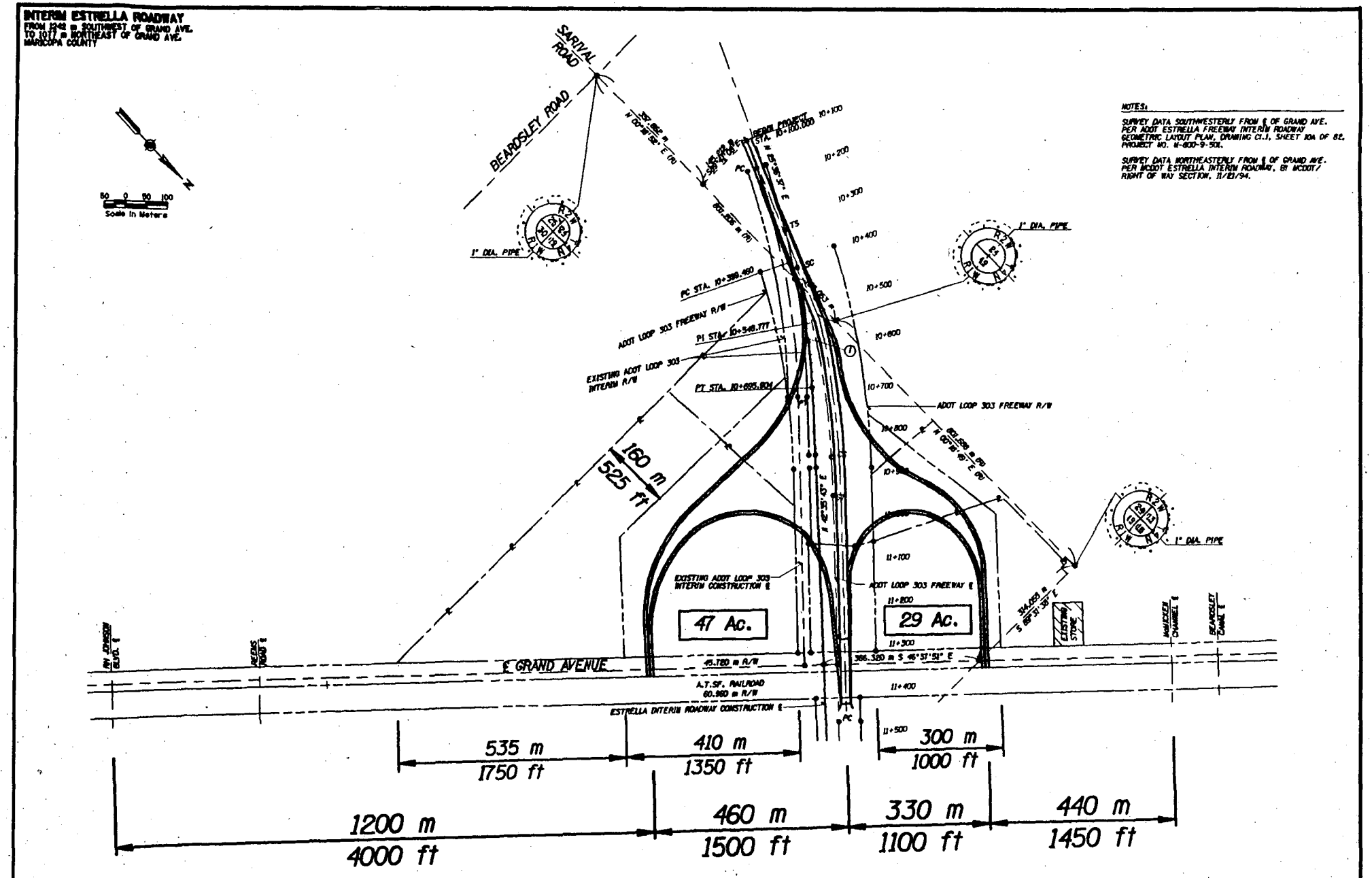
APPLE PLOT

FIGURE 8

ALTERNATES FOR REALIGNMENT OF 163RD AVENUE

ALT	DESCRIPTION	ESTIMATE CONSTRUCTION COST (1996 $)
Alt A	North Alignment	$2.0M
Alt B	South Alignment	$1.5M*

* Excluding Alignment Modification South of Estrella Roadway



① CURVE DATA	② CURVE DATA	③ CURVE DATA
Δ = 15°39'08"	Δ = 03°14'15"	Δ = 04°00'39"
R = 1000.000 m	R = 2000.000 m	R = 6885.501 m
L = 256.448 m	L = 112.952 m	L = 498.882 m
T = 148.317 m	T = 56.496 m	T = 244.394 m

FIGURE 9

APPENDIX A

ESTRELLA FREEWAY DESIGN CONCEPT DRAWINGS BY ADOT

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	AZM-600-9-301	18	45	

STA. 1080+00

MATCH LINE

PROPOSED DIRT DRAINAGE CHANNEL @ 0.15% SLOPE STA. 1098+90.00 S.A. 303L

STA. 20+00 PROP. LITCHFIELD ROAD

STA 1098+90.00
MID-SECTION TIE
N 972998.9453
E 350257.3744

NEW R/W

N 25°36'37" E

RAMP A

RAMP B

RAMP C

RAMP D

FRONTAGE ROAD A

FRONTAGE ROAD B

PROPOSED 4-36"RCP

EXST. ELECTRIC (OVERHEAD) (A.P.S.)

PROPOSED DIRT DRAINAGE CHANNEL @ 0.63% SLOPE

PROPOSED 3-36" RCP

PROPOSED DIRT DRAINAGE CHANNEL @ 0.07% SLOPE

EXST. 20' DIRT ROAD

EXST. 22' DIRT ROAD

EXST. 24' DIRT ROAD

EXST. 6" GAS LINE (SOUTHWEST GAS)

EXST. ELECTRIC OVERHEAD (A.P.S.)

EXST. TELE. (BURIED) (U.S. WEST COMM.)

EXST. 150' R/W (HDWY)

EXST. 200' R/W (S.R.)

EXST. 40' R/W (HDWY)

SECTION LINE

DEER VALLEY DRIVE

1090 ROAD

1100

1110

1120

1130

AVENUE

SPIRAL DATA
a=1/3
Δs=01°30'00"
Ls=300.00'
t=150.00'
"o"=0.65'

STA. 1098+08

E350.000
N974.000

TOTAL CURVE
Δ=17°45'35"
R+"o"=5730.23'
T=1045.27
L=2075.98'
EXT=70.17'

MAIN CURVE
Δ=14°45'35"
D=01°00'00"
R=5729.58'
L=1475.98'

STA. 1101+71.05
SECTION TIE
N 973248.4721
E 350386.6318

STA. 1091+00

T.S. 1097+06.18

PROPOSED LITCHFIELD S.C. 1100+06.18

C.S. 1114+82.16

S.T. 1117+82.16

STA. 1110+66.05
N 975419.1690
E 352228.6419

STA. 1130+66.05
S.A. 303L
STA. 20+00
GRAND AVE.

GRAND AVENUE

A.T.&S.F.

STA. 1140+00

MATCH LINE

T.4N. R.2W.

T.4N. R.1W.

N 00°19'00" E 2278.22

SECTION LINE

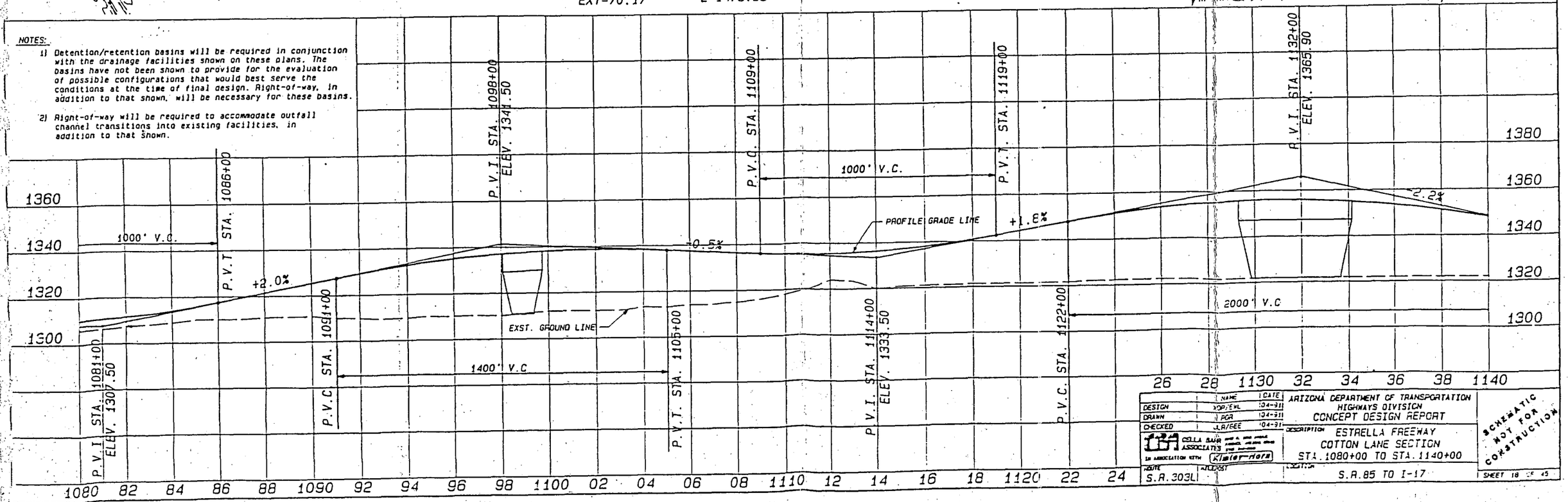
Scale: HORIZ. 200' 0' 200' 400'

Scale: VERT. 20' 0' 20' 40'

NOTES:

1) Detention/retention basins will be required in conjunction with the drainage facilities shown on these plans. The basins have not been shown to provide for the evaluation of possible configurations that would best serve the conditions at the time of final design. Right-of-way, in addition to that shown, will be necessary for these basins.

2) Right-of-way will be required to accommodate outfall channel transitions into existing facilities, in addition to that shown.



	NAME	DATE
DESIGN	WDP/EWL	04-91
DRAWN	PGR	04-91
CHECKED	JLR/BEE	04-91

CELLA BARR ASSOCIATES
In association with Wilson-Moore

ROUTE S.R.303L | MILEPOST

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
CONCEPT DESIGN REPORT

DESCRIPTION ESTRELLA FREEWAY
COTTON LANE SECTION
STA. 1080+00 TO STA. 1140+00

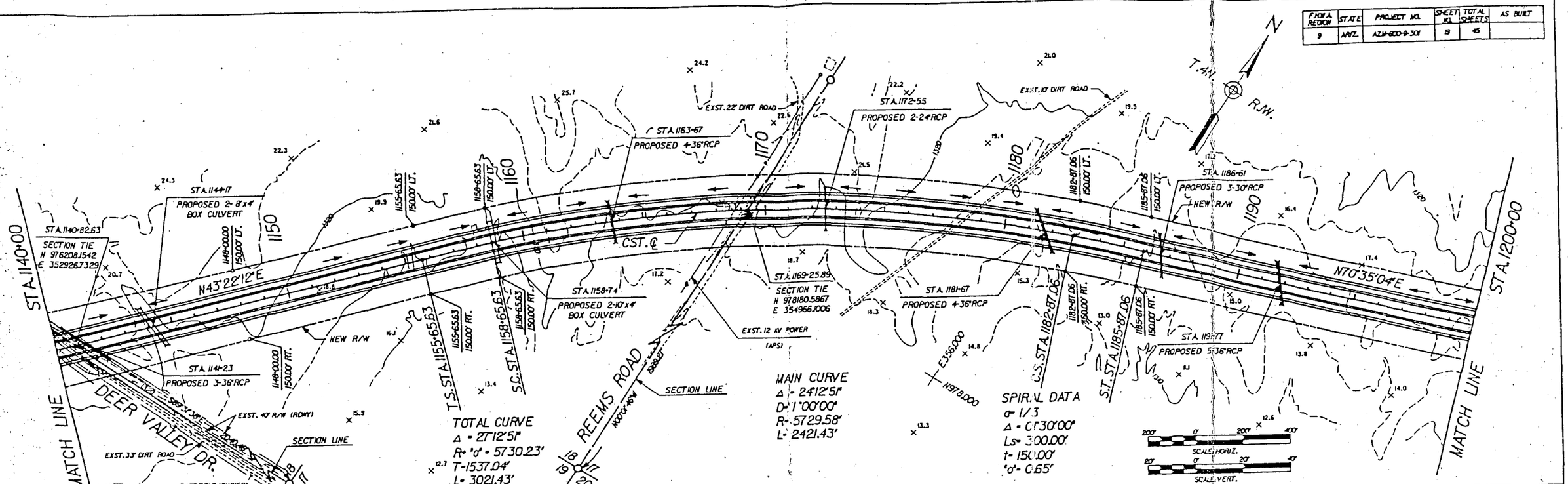
LOCATION S.R.85 TO I-17

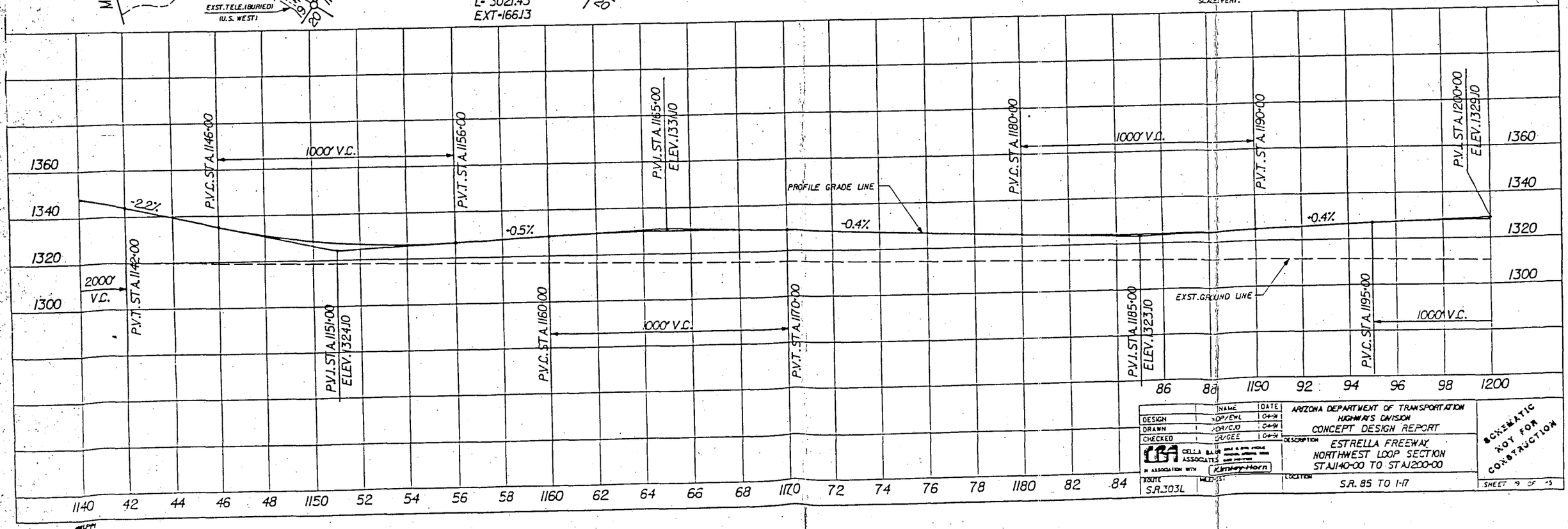
SCHEMATIC NOT FOR CONSTRUCTION

SHEET 18 OF 45

CTN.PP.:9

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	AZM-600-9-301	13	45	





	NAME	DATE
DESIGN	JDP/EWL	04-91
DRAWN	JDP/CJO	04-91
CHECKED	JAJ/GEE	04-91

CELLA BARR ASSOCIATES
IN ASSOCIATION WITH Kimley-Horn

ROUTE S.R.303L | SECT. | LOCATION S.R. 85 TO I-17

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
CONCEPT DESIGN REPORT
DESCRIPTION ESTRELLA FREEWAY
NORTHWEST LOOP SECTION
STA.1140+00 TO STA.1200+00

SCHEMATIC NOT FOR CONSTRUCTION

SHEET 9 OF 13

APPENDIX B

COST ESTIMATE DETAILS

TABLE 1

INTERIM ESTRELLA ROADWAY
RAILROAD CROSSING STUDY

BASE COST ESTIMATES
INTERIM ROAD VS. GRADE SEPARATION

			INTERIM ROAD in 1996		1/2 BRIDGE in 1997		FULL BRIDGE in 1997	
ITEM NO.	ITEM DESCRIPTION	UNIT PRICE (METRIC)	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
107.011	N.P.D.E.S.	10,000.00 L.S.	1.0 L.S.	10,000.00	1.0 L.S.	10,000.00	1.0 L.S.	10,000.00
110.01	MOBILIZATION	50,000.00 L.S.	1.0 L.S.	50,000.00	1.5 L.S.	75,000.00	1.5 L.S.	75,000.00
205.03	ROADWAY EXCAVATION	5.23 c.m.	2,217.3 c.m.	11,596.48	1,000.0 c.m.	5,230.00	1,000.0 c.m.	5,230.00
210.042	BORROW	7.85 c.m.	42,050.5 c.m.	330,096.43	95,000.0 c.m.	745,750.00	240,000.0 c.m.	1,884,000.00
215.037	DETENTION BASIN EXCAVATION	7.85 c.m.	765.0 c.m.	6,005.25	2,000.0 c.m.	15,700.00	2,000.0 c.m.	15,700.00
225.09	WATERING	500.00 L.S.	1.0 L.S.	500.00	3.0 L.S.	1,500.00	3.0 L.S.	1,500.00
301.01	SUBGRADE PREPARATION	1,868.00 km	2.2 km	4,109.60	2.2 km	4,109.60	2.7 km	5,043.60
310.071	AGGREGATE BASE COURSE (TON)	10.00 M. TON	12,423.9 M. TON	124,239.00	11,580.0 M. TON	115,800.00	14,100.0 M. TON	141,000.00
315.07	BITUMINOUS PRIME COAT (TON) (CONTINGENT ITEM)	111.00 M. TON	10.9 M. TON	1,209.90	10.9 M. TON	1,209.90	13.1 M. TON	1,454.10
321.021	ASPHALT CONCRETE PAVING C-3/4	39.70 M. TON	10,300.0 M. TON	408,910.00	7,700.0 M. TON	305,690.00	9,200.0 M. TON	365,240.00
329.07	BITUMINOUS TACK COAT (TON) (CONTINGENT ITEM)	111.00 M. TON	10.9 M. TON	1,209.90	10.9 M. TON	1,209.90	10.9 M. TON	1,209.90
336.081	PAVEMENT SAWCUT	32.80 m	400.0 m	13,120.00	12.0 m	393.60	12.0 m	393.60
401	TRAFFIC CONTROL	1,500.00 L.S.	1.0 L.S.	1,500.00	1.0 L.S.	1,500.00	1.0 L.S.	1,500.00
618.02324	24" RGRCP, CLASS III	180.42 m	159.0 m	28,686.78	23.0 m	4,149.66	23.0 m	4,149.66
623.01524	24" MAG IRRIGATION HW WTR (501-4)	7,000.00 EA	1.0 EA	7,000.00	0.0 EA	0.00	0.0 EA	0.00
623.01424	24" MAG HEADWALL	2,000.00 EA	4.0 EA	8,000.00	2.0 EA	4,000.00	2.0 EA	4,000.00
618.02336	36" RGRCP, CLASS III	212.50 m.	156.0 m.	33,150.00	1,226.0 m.	260,525.00	1,726.0 m.	366,775.00
	PIPE/DITCH TRANSITION	800.00 EA	3.0 EA	2,400.00	3.0 EA	2,400.00	3.0 EA	2,400.00
	D.G. (MEDIAN)	1.10 S.m.	2,000.0 S.m.	2,200.00	0.0 S.m.	0.00	0.0 S.m.	0.00
	MEDIAN CURB	13.13 m	413.0 m	5,422.69	0.0 m	0.00	0.0 m	0.00
	UTILITY RELOCATIONS	15,000.00 L.S.	1.0 L.S.	15,000.00	1.0 L.S.	15,000.00	1.0 L.S.	15,000.00
	TRAFFIC SIGNAL (GRAND AVE.)	100,000.00 L.S.	1.0 L.S.	100,000.00	0.0 L.S.	0.00	0.0 L.S.	0.00
	RAILROAD SIGNAL CROSSING	150,000.00 L.S.	1.0 L.S.	150,000.00	0.0 L.S.	0.00	0.0 L.S.	0.00
	SIGNS AND MARKINGS	8,000.00 L.S.	1.0 L.S.	8,000.00	1.0 L.S.	8,000.00	1.0 L.S.	8,000.00
	BRIDGE	550.00 S.m.	0.0 S.m.	0.00	1,890.0 S.m.	1,039,500.00	3,780.0 S.m.	2,079,000.00
	LOOP 303 REALIGN.	200,000.00 L.S.	0.0 L.S.	0.00	1.0 L.S.	200,000.00	1.0 L.S.	200,000.00
	MAG HEADWALLS–36"	5,000.00 EA	2.0 EA	10,000.00	6.0 EA	30,000.00	6.0 EA	30,000.00
	TRANSITION (DIVIDED TO UNDIVIDED)	150,000.00 L.S.	0.0 L.S.	0.00	0.0 L.S	0.00	1.0 L.S.	150,000.00
	SUBTOTALS			$1,332,356.02		$2,846,667.66		$5,366,595.86
	CONTINGENCY	5%		$66,617.80		$142,333.38		$268,329.79
	SUBTOTALS			$1,398,973.83		$2,989,001.04		$5,634,925.65
	CONSTRUCTION ENGINEERING	10%		$139,897.38		$298,900.10		$563,492.57
	GRAND TOTAL			$1,538,871.21		$3,287,901.15		$6,198,418.22

Gannett Fleming
ENGINEERS AND PLANNERS

SUBJECT Interim Estrella Roadway
WORK ORDER 38869
BY GLF DATE 1-8-96 CHKD. BY CDT DATE 1-11-96

SHEET NO. 1 OF
JOB NO. 29862

COST ESTIMATE ADJUSTMENTS

1. WIDENED 1/2 BRIDGE

USE 1/2 BRIDGE COST AS A BASE = $3.3 Million

Additional Structure (22.2 - 16.8)(150) = 810 SM = $0.5 million
" Embankment - Estimate $0.3 million
" Conc. Barrier = 150 M = $0.03 million

Results = Extra $0.83 million
Base = 3.3 million

Total = $4.1 Million

2. 163rd Avenue Realignment

ALT. B

Beardsley Canal Bridge	$400,000 Lump Sum
McMicken Channel Bridge	$200,000 Lump Sum
Drainage / Floodplains	$200,000 Lump Sum
Paving & Grading	$700,000 Lump Sum (1.8 miles)
	$1.5 million

ALT. A = Similar to ALT. B plus 3 new towers @ $170,000 / tower = $500,000

ALT. A = $2.0 Million

Gannett Fleming
ENGINEERS AND PLANNERS

SUBJECT Interim Estrella Roadway Costs
BY GLF DATE 2/5/96 CHKD. BY CDT DATE 2/9/96

SHEET NO. 2 OF 2
JOB NO. 29862

3. Interchange Ramps with widened 1/2 Bridge

Reference Report Figure 9

Item	Unit Price	Quantity	Cost
Borrow	7.85 / CM	200,000	1,570,000
AB	10.00 / MT	15,000	150,000
Paving	39.70 / MT	12,000	476,400
Drainage	400,000 / LS	1	400,000
Signals	100,000 / EA	2	200,000
M&P Traffic	50,000 / LS	1	50,000

Sub Total	2,846,400
20% Contingencies	580,000
Total	= 3,426,400

SAY @ 3.5 Million

APPENDIX C

DRAINAGE ISSUES ON 163RD AVENUE

Realignment of 163rd Ave
Drainage Issues

This report is based on data contained in the "Whittmann Area Master Drainage Study, Part A: Hydrology and Hydraulics and Part B: Stormwater Management Plans". Gannett Fleming, Inc. also used an aerial photo and the USGS 7.5 minute topographic map McMicken Dam Quadrangle to analyze the current drainage conditions. Included with this report is an exhibit which shows the proposed roadway alignments and relevant drainage data. We have also included a copy of the FIRM map which shows the extent of the floodplains in the region.

The design of the realignment of 163rd Ave. should take into consideration the following drainage issues:

Discharge from the CAP5EAST culvert.

The unmaintained dike to the north of the closed Luke Auxiliary Field (LAF).

The box culvert under 163rd Ave. at Happy Valley Road (HVR).

The existing channel along the North side of Happy Valley Road east of 163rd Ave. to approximately Bullard Ave.

The floodplain northeast of 163rd Ave. and north of the Beardsley Canal.

The floodplain between the Beardsley Canal and the McMicken Dam Outlet Channel.

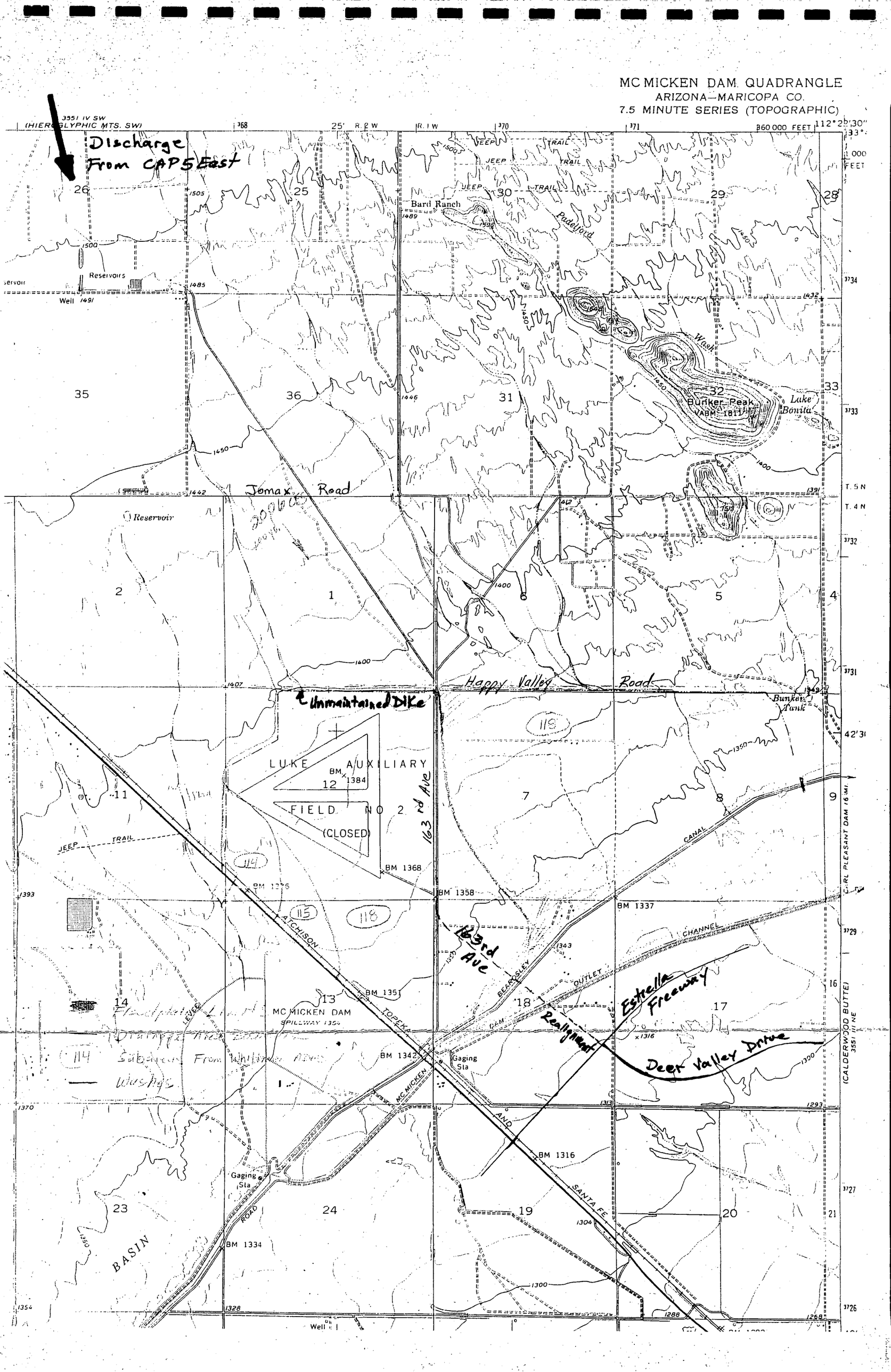
The crossing of the Beardsley Canal and the McMicken Dam Outlet Channel.

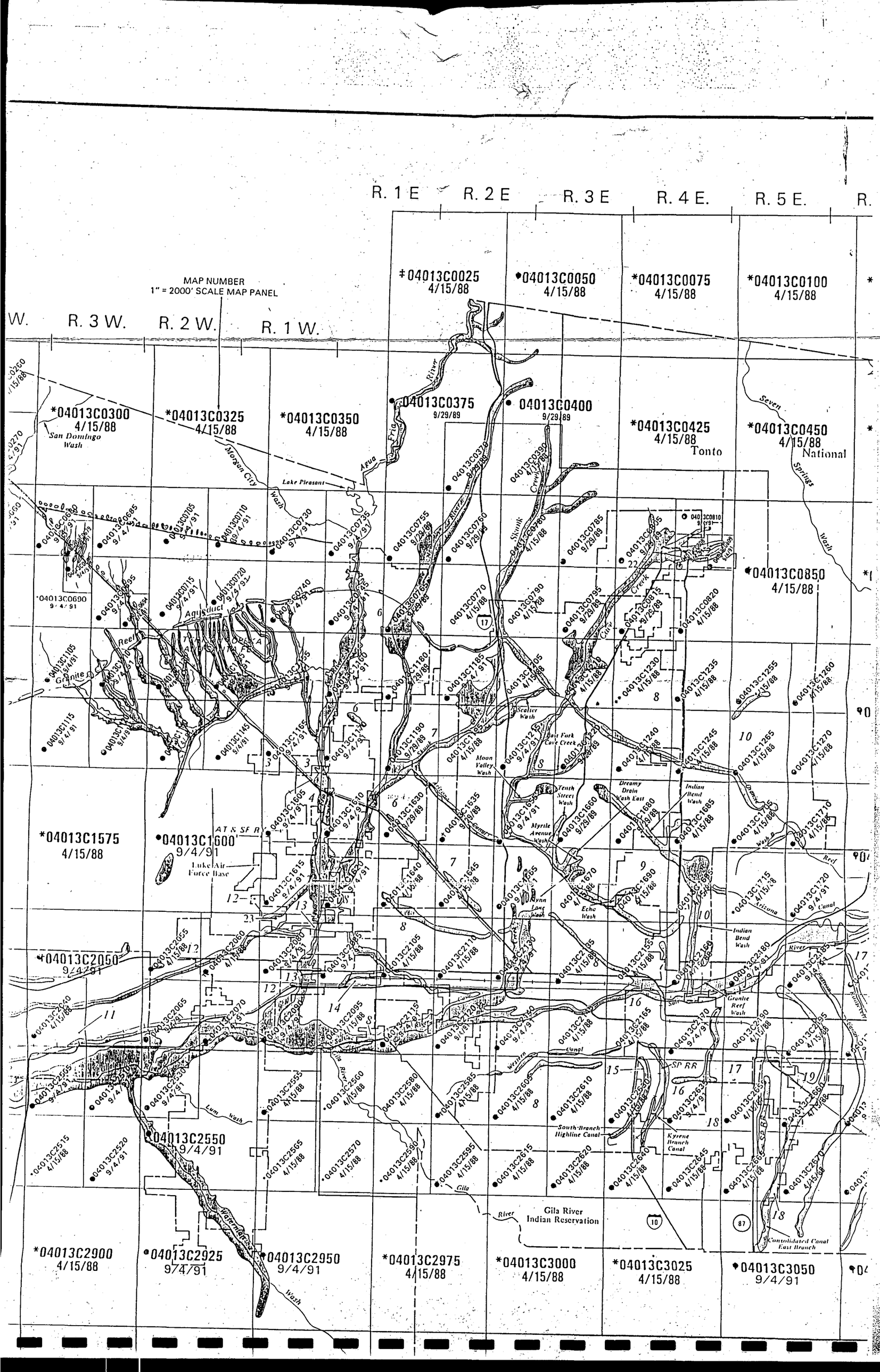
The most important item to consider is the discharge from the CAP5EAST culvert. This culvert passes storm flows under the CAP canal at a point which is approximately 16,000 feet east of the CAP crossing of Grand Ave. (when measured along the CAP). The discharge from this culvert travels south east until it reaches the unmaintained dike on the north side of the Luke Auxiliary Field. The water then flows east along HVR in a channel, passing under 163rd Ave in a box culvert. The storm runoff continues east along HVR in a channel for approximately 8,000 feet before turning south to the Beardsley Canal. This runoff contributes to the existing floodplain which currently exists north of the Beardsley Canal and east of 163rd Ave. If the unmaintained dike at LAF, the box under 163rd Ave at HVR or the channel along HVR fail or have inadequate capacity the 100 year storm flows will travel further south and adversely impact the realigned 163rd Ave. The realignment of

163rd Ave. does not warrant large expenditures for offsite drainage improvements. But a discussion with the Flood Control District of Maricopa County to determine their master plan for this area will ensure that the 163rd Ave. realignment can be properly located and designed.

The realignment of 163rd Ave will require crossing both the Beardsley Canal (BC) and the McMicken Dam Outlet Cannel (MDOC). The BC has an existing floodplain along it's north and west side. The area between the BC and the MDOC is a floodplain. Therefore, the design of this realignment will have to include a series of equilibrium culverts to prevent the storm runoff from ponding on one side of the road and to prevent the movement of the floodplain limits. We recommend crossing the BC by enclosing the canal in precast box culverts. The use of precast box culverts would simplify construction, reduce the required canal dry up period and reduce the complexity of widening the road in the future. We recommend crossing the MDOC with a bridge. The use of a bridge is recommended because of the fact that this structure will be downstream of an existing dam. In the event of a catastrophic storm or series of storms the chance of a bridge washing out is lower than that for a box. Furthermore, the bridge and road could be designed so that during the extreme flood the road will act as a broad weir and the bridge will still have available freeboard to pass water. This type of layout will ensure that the realignment does not change existing conditions by allowing water to pass from the north of the MDOC to the south side of the channel.

The Whittman Area Drainage Master Study Part B includes a solution to flooding problems in this area that may reduce the costs and liability of constructing a road through an existing floodplain. Solution 13.1 states that existing culverts into the Beardsley Canal located about 2100 feet east of Grand Ave. are crushed. The report suggests replacing these culverts and increasing the height of the existing canal. Further study would be required to verify that Solution 13.1 would in fact reduce or eliminate the floodplain within the vicinity of realigned 163rd Ave. on the north side of BC. The implementation of Solution 13.1 would probably eliminate the need for equilibrium culverts north of the BC.


MC MICKEN DAM QUADRANGLE
ARIZONA—MARICOPA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
Discharge From CAP5 East
Bard Ranch
Padelford
Reservoirs
Well
Bunker Peak
ABM 1811
Luke Bonita
Jomax Road
Reservoir
Unmaintained Dike
Happy Valley Road
LUKE AUXILIARY FIELD NO 2 (CLOSED)
BM 1384
BM 1368
BM 1358
BM 1337
BM 1351
BM 1342
BM 1316
BM 1334
163rd Ave
CANAL
CHANNEL
OUTLET
ATCHISON TOPEKA AND SANTA FE
BEARDSLEY
MC MICKEN DAM
SPILLWAY
Gaging Sta
Estrella Freeway
Realignment
Deer Valley Drive
ROAD
BASIN
JEEP TRAIL
Drainage Area Boundary
Subbasins From Whitman Area
Washes
C.R.I.P. PLEASANT DAM 16 MI.
(CALDERWOOD BUTTE)


MAP NUMBER
1" = 2000' SCALE MAP PANEL
R. 1 E
R. 2 E
R. 3 E
R. 4 E.
R. 5 E.
R. 3 W.
R. 2 W.
R. 1 W.
*04013C0025 4/15/88
*04013C0050 4/15/88
*04013C0075 4/15/88
*04013C0100 4/15/88
*04013C0300 4/15/88
*04013C0325 4/15/88
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04013C0375 9/29/89
04013C0400 9/29/89
*04013C0425 4/15/88
*04013C0450 4/15/88
*04013C0850 4/15/88
*04013C1575 4/15/88
*04013C1600 9/4/91
*04013C2050 9/4/91
*04013C2550 9/4/91
*04013C2900 4/15/88
*04013C2925 9/4/91
*04013C2950 9/4/91
*04013C2975 4/15/88
*04013C3000 4/15/88
*04013C3025 4/15/88
*04013C3050 9/4/91
San Domingo Wash
Morgan City Wash
Lake Pleasant
Agua Fria River
Tonto
National
Seven Springs Wash
Skunk Creek
Reems Wash
Granite Reef Wash
Aqueduct
Luke Air Force Base
AT & SF R
Moon Valley Wash
Tenth Street Wash
Myrtle Avenue Wash
Dreamy Drain Wash East
Indian Bend Wash
Lynn Lane Wash
Echo Wash
Arizona Canal
Western Canal
South Branch Highline Canal
Kyrene Branch Canal
Consolidated Canal East Branch
Gila River
Gila River Indian Reservation
Hassayampa River
Luna Wash
Wash
10
87
17

APPENDIX D

MEETING MINUTES

Gannett Fleming
ENGINEERS AND PLANNERS

GANNETT FLEMING, INC.
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Office: (602) 553-8817

ESTRELLA RAILROAD CROSSING ALTERNATIVES
Meeting Minutes
January 31, 1996

The meeting convened at 10:00 am in the Apache conference room of MCDOT. Copies of the agenda and handout material were distributed, the attendance sign in sheet is attached.

Tom Buick opened the meeting and outlined the agenda and meeting purpose. Following instructions, George Flanagan provided an overview of the project and status of the design work on the interim at-grade road project (70% plans complete). The following questions/issues were raised:

- Existing Deer Valley Drive no longer exists in the vicinity of the Estrella (Rudy San Miguel).
- Alt. B for 163rd Avenue realignment would not be acceptable to Del Webb due to its intrusion into a developing area (Nick Taratsas).
- At-grade railroad crossing for the Estrella Roadway is not acceptable to the BNSF Railroad (Rudy San Miguel).
- ADOT's design concept for the access to Grand Avenue is no longer acceptable (i.e., frontage roads from Grand Avenue to a new T.I. at Litchfield Road). It requires too much indirect routing and Del Webb is not planning for an interchange at their crossing of the Estrella. (Nick Taratsas and Al Ambrock).
- The proposed ADOT right-of-way is 600 feet wide west of Grand Avenue (to allow for the ramps and frontage roads) and 300 feet wide east of Grand Avenue.

George Flanagan then proceeded to describe the seven alternatives for the Estrella/Railroad crossing (see handout material). This included both present and future costs as well as safety issues and construction issues. The recommended alternative is number 7, the widened half bridge. This would consist of a bridge wide enough to carry two lanes of traffic in each direction with shoulders and a concrete barrier in the median. Initially, the bridge would be striped for one lane in each direction, and then re-striped in the future when warranted by traffic. The two alternatives for realigning 163rd Avenue were studied to identify the costs associated with eliminating the 163rd Avenue at-grade railroad crossing. Questions and comments included:

- Access needs to be provided at Grand Avenue to and from the Estrella, a partial cloverleaf was sketched on the display map.
- ADOT expressed concern about the need for two signals on Grand Avenue if a partial cloverleaf were built.
- Other alignment concepts for 163rd Avenue could be less costly.
- The partial cloverleaf construction would add another 3 to 4 million dollars to the cost estimate and would significantly increase the right-of-way costs.

Tom Buick then led a discussion on funding scenarios. The consensus appeared to favor alternative 7, but modification was needed to provide access at Grand Avenue. The attached mark-up of the funding options display was developed as a rough guide of where funding might come from.

It was agreed that a follow-up meeting was necessary in order to explore the access issue at Grand Avenue. A date was set on Feb. 22, 1996 at 10:00am. The agenda will include cost and right-of-way issues for the interchange at Grand Avenue and additional discussion of funding availability from all involved stakeholders.

MEETING ATTENDANCE

NAME	AFFILIATION	PHONE
Charles Bingham	Gannett Fleming	553-8817
George Flanagan	" "	" "
Kent McLain	MCDOT - Engrg.	506-8623
Joe Spadafino (for Larry Lazer)	ADOT-VAM	255-7723
AL Ambrecht	Land Cons	951-3218
MIKE PIERCE	"	840-2490
NICK TAPATSAS	DEL WEBB	546-7021
STEVE HANSEN	ADOT-R/W	255-7316
Wes66 CROCKETT	BNSFRR	257-5333
RUDY SAN MIGUEL	BNSF RR	509 386447A
Grey Holveyson	MCDOT-TPD	506-8744
BILL PARRISH	CITY of Surprise	583-1088
GEORGE CHIN	ADOT	255-7193
Tom Buick	MCDOT	506-4622
Jim Minter	MC attorney	506-8541

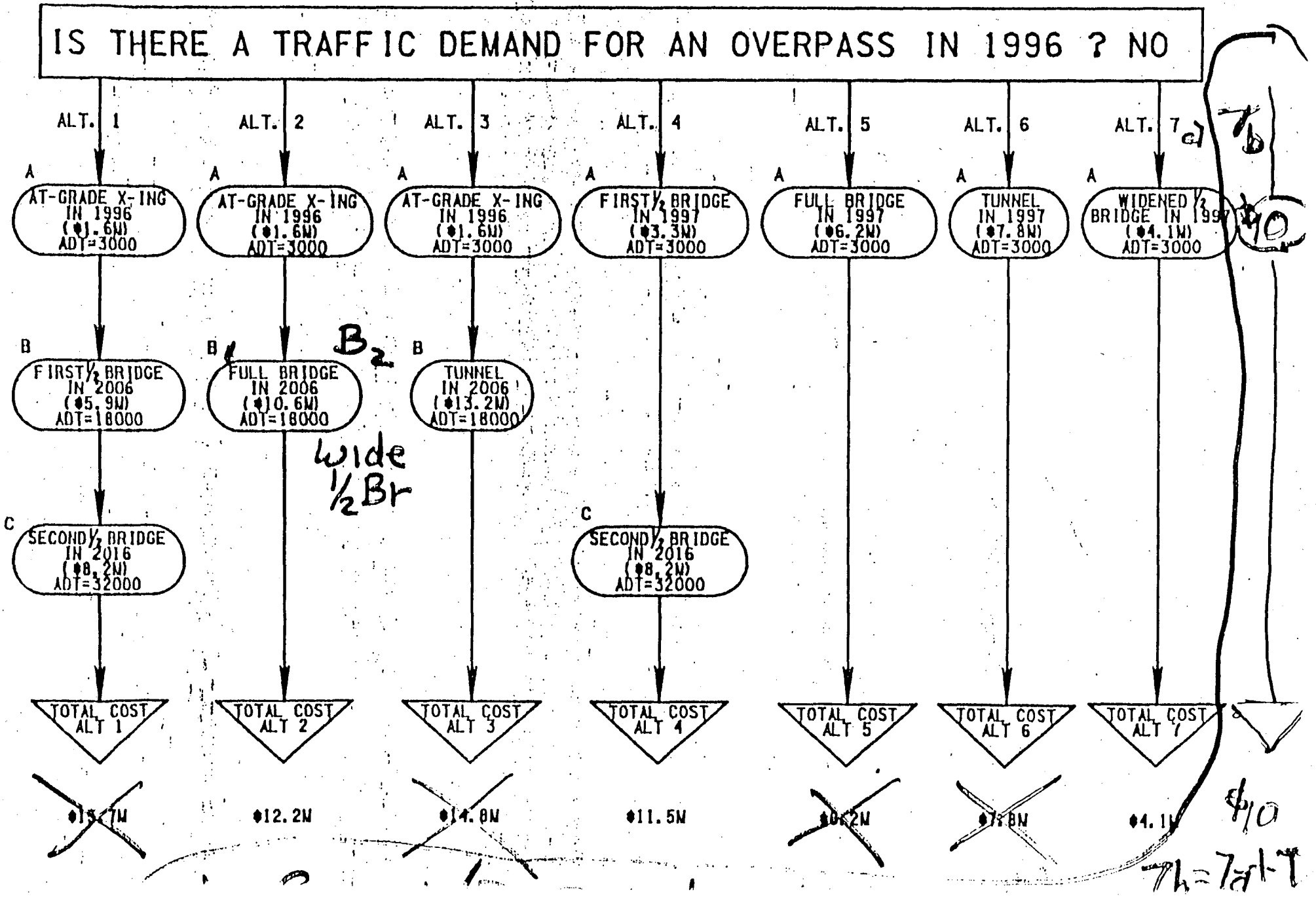
ESTRELLA RAILROAD CROSSING ALTERNATIVES MEETING

PROJECT LOCATION:	250' Northeast of Grand Avenue and SR303 Intersection
DATE OF MEETING:	Wednesday, January 31, 1996
TIME:	10:00 a.m.
LOCATION OF MEETING:	Maricopa County Department of Transportation Apache Conference Room 2901 West Durango Street Phoenix, Arizona 85009

AGENDA

1.	Introduction	Louis Schmitt, MCDOT
2.	Discussion of Railroad Crossing Alternatives Gannett Fleming A. Current At Grade B. Half Bridge (Staged) C. Full Bridge D. 163rd Realignment E. Below Grade	George Flanagan,
3.	Evaluation of Alternatives A. Advantages/Disadvantages B. Recommended Alternative	George Flanagan, Gannett Fleming
4.	Funding A. Private Sector B. BNSF Railroad C. MCDOT D. ADOT E. Federal F. Cities	Louis Schmitt, MCDOT
5.	Implementation Plan A. Lead Agency B. Timing C. Coordination Activities	Louis Schmitt, MCDOT
6.	Questions and Answers	All
7.	Adjournment	

RAILROAD CROSSING ALTERNATIVES



FUNDING OPTIONS
(Future $)

7b 7c

Funding Source	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
	$	$	$	$	$	$	$
Private	0.5	0.5					
Railroad	-0-	-0-					
MCDOT	1.6	1.6					1.6
ADOT	4.0	4.0					2.5
Federal	-0-	-0-					
Cities	0.1	0.1					
Totals	~~$15.7M~~	$12.2M	$14.8M	$11.5M	$6.2M	$7.8M	$4.1M

$10M +ROW

12M +ROW

-163rd

4.1

+ Rail protection

Gannett Fleming
ENGINEERS AND PLANNERS

GANNETT FLEMING, INC.
Suite 130
3001 East Camelback Road
Phoenix, AZ 85016-4498
Fax: (602) 553-8816
Office: (602) 553-8817

Meeting Minutes

Subject: Interim Estrella Roadway - Access at Grand Avenue
Date: February 22, 1996 @ 10:00am
Location: MCDOT, Apache Conference Room
Attendees: See attached list

Following a self-introduction by each attendee, Louis Schmitt gave a brief introduction, background and purpose of this meeting. George Flanagan then reviewed the meeting minutes from the January 31, 1996 meeting and summarized that meeting's major conclusions:

- Alt. 7 (widened Half-Bridge) was the preferred alternative
- Direct access was needed at Grand Avenue to/from the Estrella Roadway
- Funding uncertainties were a major concern

Since the meeting on January 31, an alternative for Grand Avenue access has been developed. Design criteria for these interchange ramps was set at 45 miles-per-hour. Mr. Flanagan reviewed this alternative which was displayed in plan view. The concept consisted of loop ramps on the west side of Grand Avenue. The ramps intersected Grand Avenue approximately 1/4 mile south and north of the Estrella Bridge (1/2 mile spacing for the signals). The estimated cost to add these ramps to Alternative 7 was $3.5 million. The total construction cost for Alternative 7 increased form $4.1 million to $7.6 million. In addition, approximately 76-acres of extra right-of-way would be needed for these ramps (the $7.6 million does not include this R/W cost).

Louis Schmitt then opened the meeting up to discussion of funding solutions. Based on input from the various agencies, no additional funding sources had been uncovered. Comments included:

- BNSF Railroad believes the County will have to re-visit the Corporation Commission before constructing the at-grade alternative. Funds from the railroad (up to 10%) can only be provided if an existing railroad crossing is closed. The proposed Estrella railroad crossing does not qualify as an existing crossing.

- ADOT has no funds available for the Estrella Corridor. The 1/2 mile spacing of signals on Grand Avenue is acceptable for traffic operations.

- Private landowners strongly favor providing access at Grand Avenue (either with an at-grade roadway or a bridge with ramps).

- Development plans for single family homes are progressing rapidly in the southwest quadrant. If the loop ramps are to be implemented, coordination needs to happen quickly amongst the County, the City of Surprise and the developer.

- Maricopa County is proceeding with the design of an at-grade roadway. 90% plans are due in March. Construction could occur as soon as December, 1996. If funding became available for Alternative 7, the at-grade plans would be modified to incorporate the widened half-bridge.

ESTRELLA RAILROAD CROSSING ALTERNATIVES MEETING

PROJECT LOCATION:	250' Northeast of Grand Avenue and SR303 Intersection
DATE OF MEETING:	Thursday, February 22, 1996
TIME:	10:00 a.m.
LOCATION OF MEETING:	Maricopa County Department of Transportation Apache Conference Room 2901 West Durango Street Phoenix, Arizona 85009

AGENDA

1.	Introduction	Louis Schmitt, MCDOT
2.	Review of January 31, 1996 Meeting A. Meeting Minutes B. Railroad Crossing Alternatives C. Preferred Alternative	George Flanagan
3.	Traffic Interchange Alignment Study A. Design Criteria B. Cost C. Right of Way	George Flanagan
4.	Funding (continued from 1-31-96) A. Private Sector B. BNSF Railroad C. MCDOT D. ADOT E. Federal F. Cities	Louis Schmitt, MCDOT
5.	Implementation Plan (continued from 1-31-96) A. Lead Agency B. Timing C. Coordination Activities	Louis Schmitt, MCDOT
6.	Questions and Answers	All
7.	Adjournment	

ATTENDANCE

2-22-96 Meeting

Name	Agency	Phone
George Flanagan	Gannett Fleming, Inc.	553-8817
Joe Spadafino	ADOT - VPMG	253-7723
GEORGE CHIN	ADOT - PHX DIST.	255-7193
Kent McLain	MCDOT - Engrg.	506-8623
Tom Buick	MCDOT	506-4622
Jan Hennessy	Del Webb	546-5010
LARRY SEMENIUK	IMC CONSULTANTS	431-1858
MIKE PIERCE	Prop owner	840-2470
AL [illegible]	[illegible]	951-37[illegible]
PAUL E. Sullivan	MCDOT Planning	506-8647
Webb Crockett	Santa Fe RR	257-5333
Rudy SanMiguel	" "	909 386 4474
Greg Halverson	MCDOT	506-8744
LARRY FOSDICK	New Ventures	840-7893
JAMES MINTER	Mar Co Atty	506-854
MIKE MCQUAID	HI WEST / JM MGT.	840-7572

CONSTRUCTION COST
FUNDING OPTIONS
(1996 $)

Funding Source	Alt. 7A Widened 1/2 Bridge	Alt. 7B Add Ramps	Alt. 7C Add 163rd Realign
Private			
Railroad			
MCDOT			
ADOT			
Federal			
Cities			
Totals	$4.1M	$7.6M	$9.1M